§45. Neutral Gas Pressure Measurement and Wall Pumping of the LHD Experiment

Suzuki, H. Ohyabu, N., Komori, A.

1.Introduction

Neutral gas pressure in the LHD plasma vacuum vessel is measured by conventional ionization gauges and fast ionization gauge (FIG). The conventional ionization gauges are installed on a gauge port of a pumping duct and they are monitoring the pressure in the plasma vacuum vessel continuously. The FIG is a special ionization gauge which is operational in a strong magnetic field without a magnetic shield[1]. A time resolution of the FIG system is about 100μs. However, in this experimental case, the time resolution is determined by a volume of the FIG chamber and conductance of the gate valve of the FIG chamber, and the time resolution is about 1ms.

The FIG are installed on 3.5L port during the first campaign and 7.5U port during the second campaign of the LHD experiment, and its data are recorded by ADC coincide with a shot trigger signal. The sampling time of the ADC is 10μs during the first campaign and 100μs during the second campaign. Using the FIG, a neutral gas pressure during and after a plasma shot is measured

2.Pumping speeds

LHD experiment is carried out using hydrogen or helium gas. The plasma vacuum vessel of the LHD has two cryopumps and four turbo molecular pumps. Pumping speeds of hydrogen and helium gas of each pump are not same, especially cryopump has no ability to pump helium gas. Using decay curves of the pressures, pumping speed of hydrogen gas is estimated to be 67m^3/s, and pumping speed of helium gas is estimated to be 16m^3/s.

3.Wall pumping

Fig.1 shows a time history of neutral gas pressures of helium gas puff shots with/without plasma under same gas puff conditions. When plasma is produced, neutral gas pressure become low because of ionization. Then the neutral gas pressure rise because of neutralization of plasma when plasma heating is stop. Finally, the pressure curve coincides with a pressure curve of no plasma case. Fig.2 shows a time history of neutral gas pressures of hydrogen gas puff shots with/without plasma under same gas puff conditions. In this case, the final pressure curve after plasma shot is not coincides with a pressure curve of no plasma case. Almost half of hydrogen molecules are missing. This is an evidence of wall pumping effect.

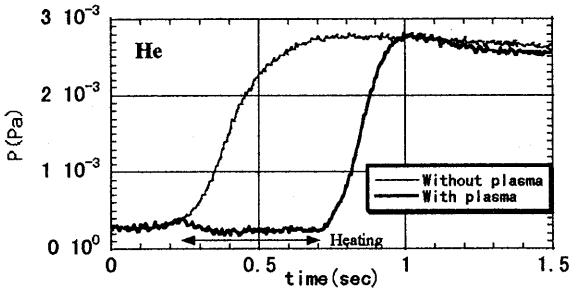

Fig.1. Time history of neutral gas pressure of helium gas shot, with/without plasma, under same gas puff condition.

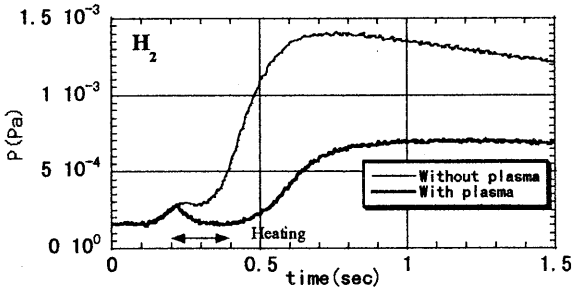

Fig.2. Time history of neutral gas pressure of hydrogen gas shot, with/without plasma, under same gas puff condition.

Reference

1) C.C.Klepper et al., J.Vac.Sci.Technol A11(1993) 446